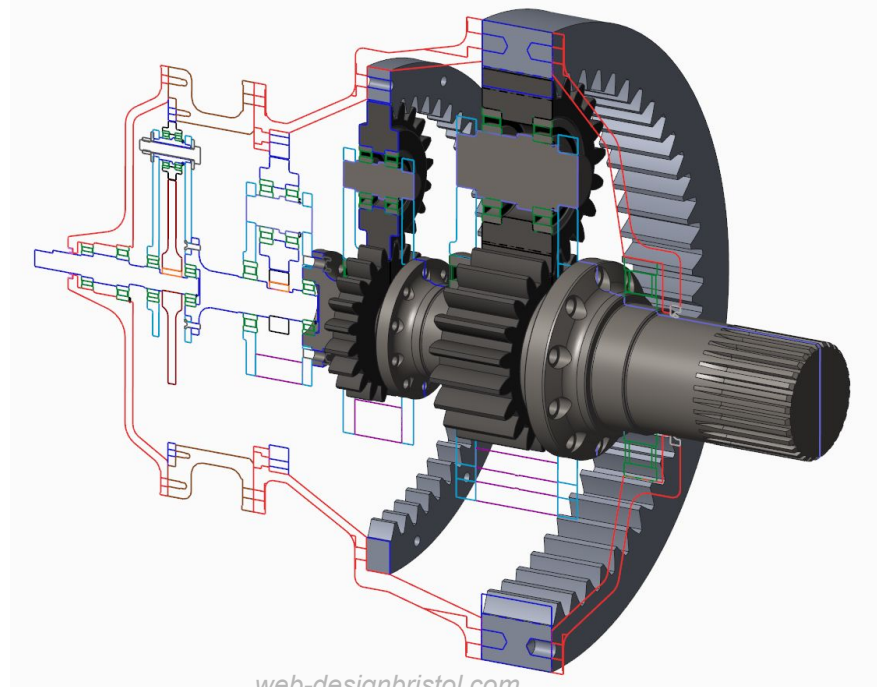


# Wanna play with Parasolid?

C. Canales\*  
26/09/2016



*web-designbristol.com*

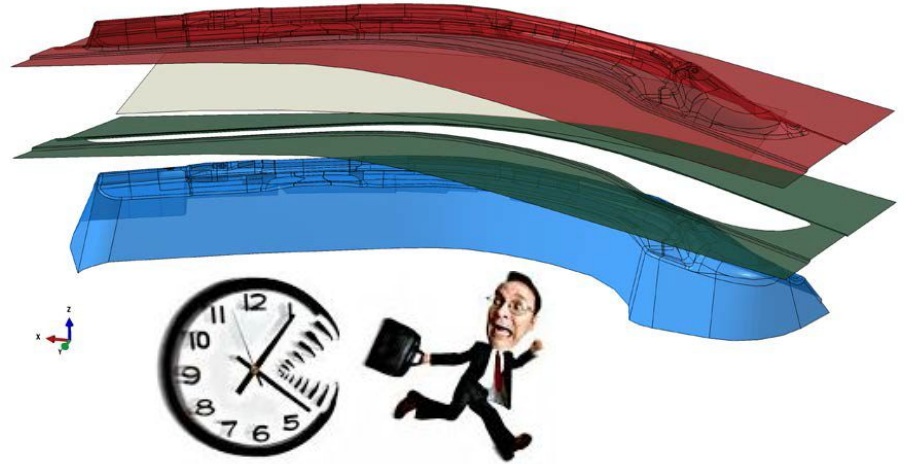
\* Yes, the little guy with glasses...

# So...What's the idea?

Until May 2016, the definition of complex contact surfaces (punch/die, mill rolls, ...) in Metafor was a time-consuming step and in some cases, impossible...

Nevertheless, the use of Parasolid as a tool for geometry generation is now available in Metafor thanks to the developments of RoBo...

By means of this new library, we can now import complex geometries into Metafor and easily define contact interactions...



# Sounds fun, but...What's Parasolid?

**Parasolid** is a geometric modeling kernel originally developed by Shape Data Limited, now owned by Siemens PLM Software. (Wikipedia)

It is used in many CAD, CAM and CAE softwares e.g., Abaqus, ANSYS, ADINA... and (almost) the entire Siemens family.

**SIEMENS**

As you may know, the A&M Department has acquired licenses for the use of the Siemens PLM softwares for academic purposes => *let's use them!*



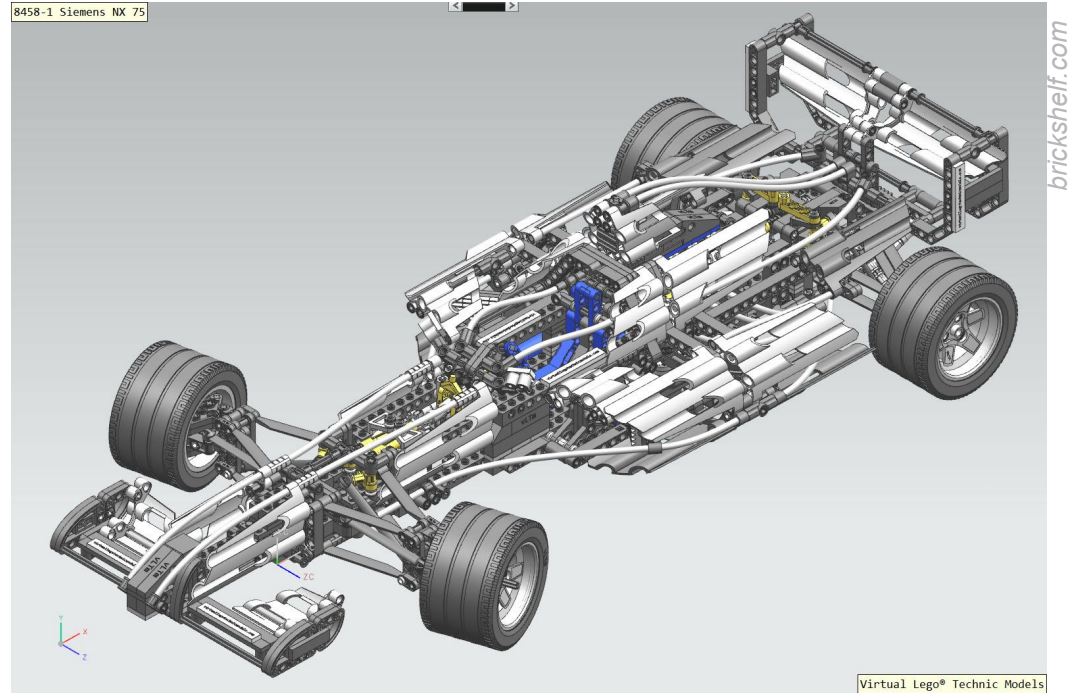
# But...What can I use to generate my own models?

From Siemens family:

- Solid Edge
- Siemens NX
- Femap (CAD & mesh)

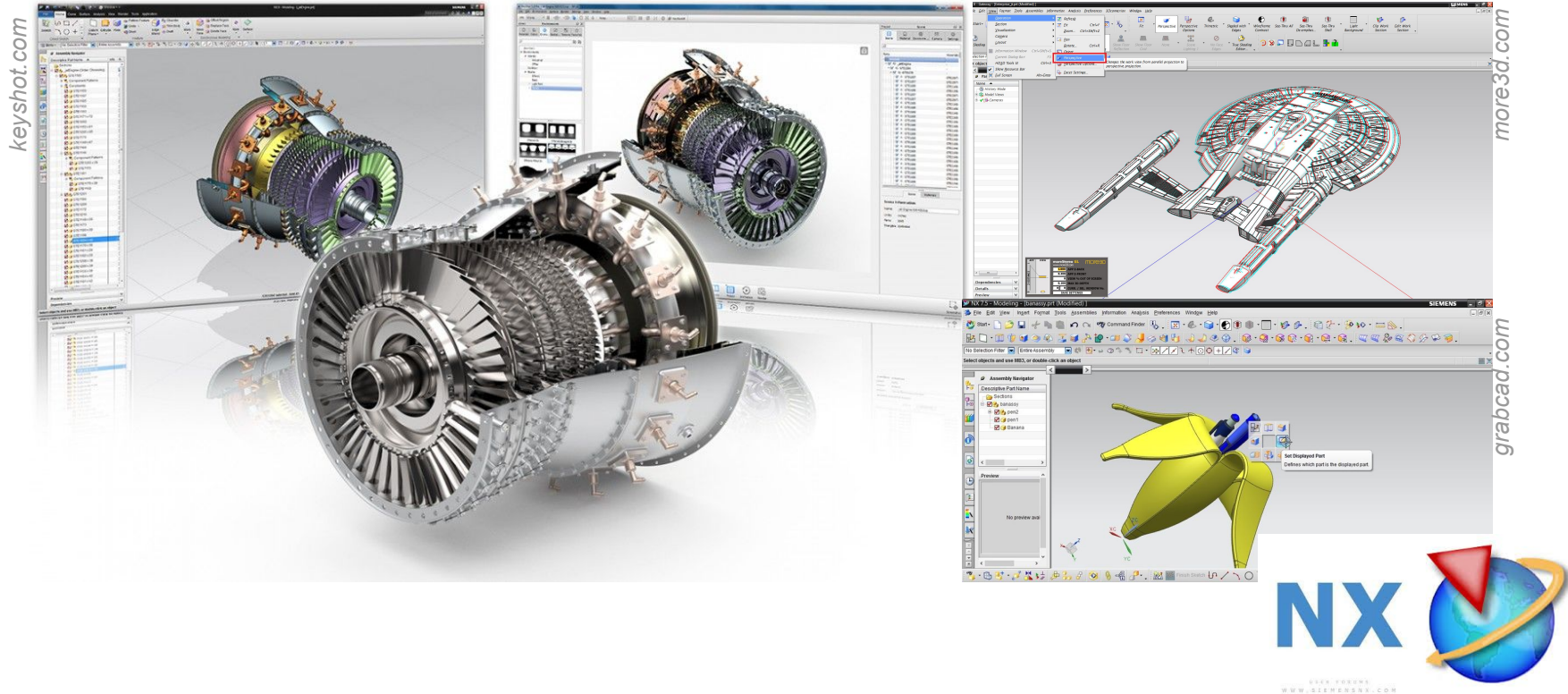
or maybe...

- Catia V5(\*)



*Just check the A&M Department's wiki for download instructions...*

# But...What can I use to generate my own models?



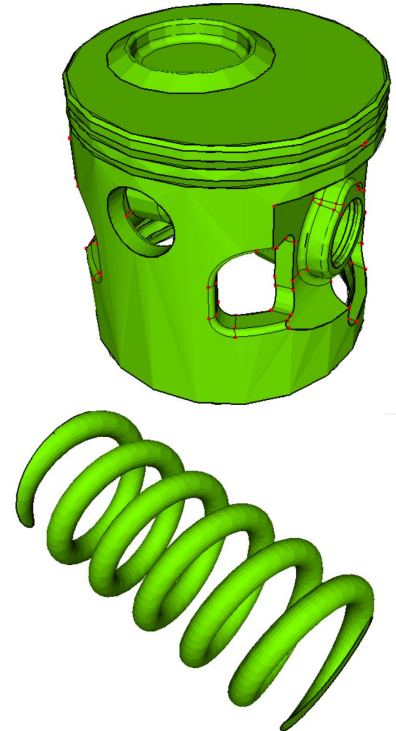
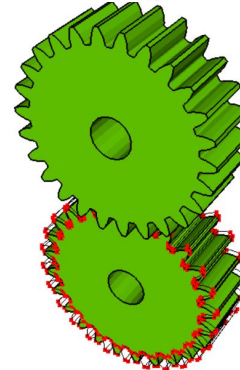
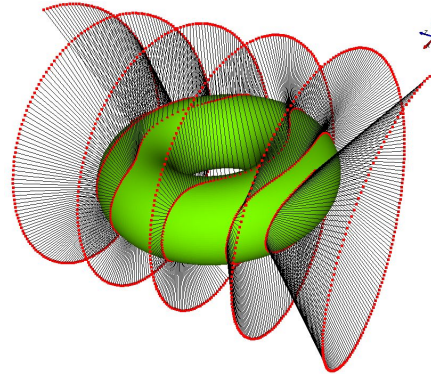
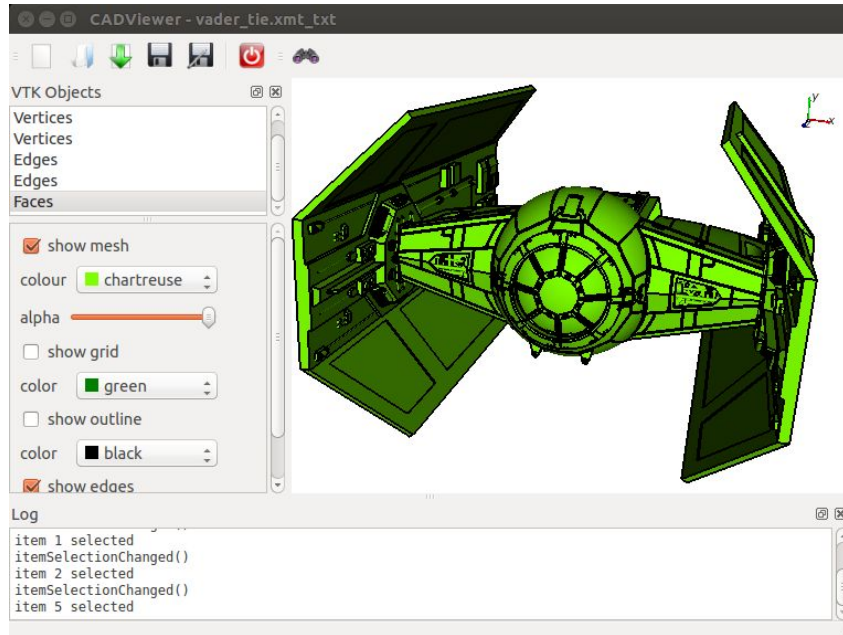
# Nice, but... What about Metafor?

- In practice, the Parasolid elements are treated as geometric objects called PSkins.
- We can translate, rotate and scale them before the time integration in Metafor.
- By defining a Skin related to the Parasolid object, we can easily define their associated contact interactions and boundary conditions.
- By the moment only frictionless contact is available, but it will be possible very soon to take friction into consideration (Gaëtan's nightmare for the moment).



# Don't forget the pki viewer!

Useful graphical interface to visualize your models and to test Parasolid.



# And...Have you done some tests?

yep! besides of the well known hydroforming test, I have been working on Numisheet-like benchmarks...

*Why Numisheet?* (*IC Numerical Simulation of 3D Sheet Metal Forming Processes*)

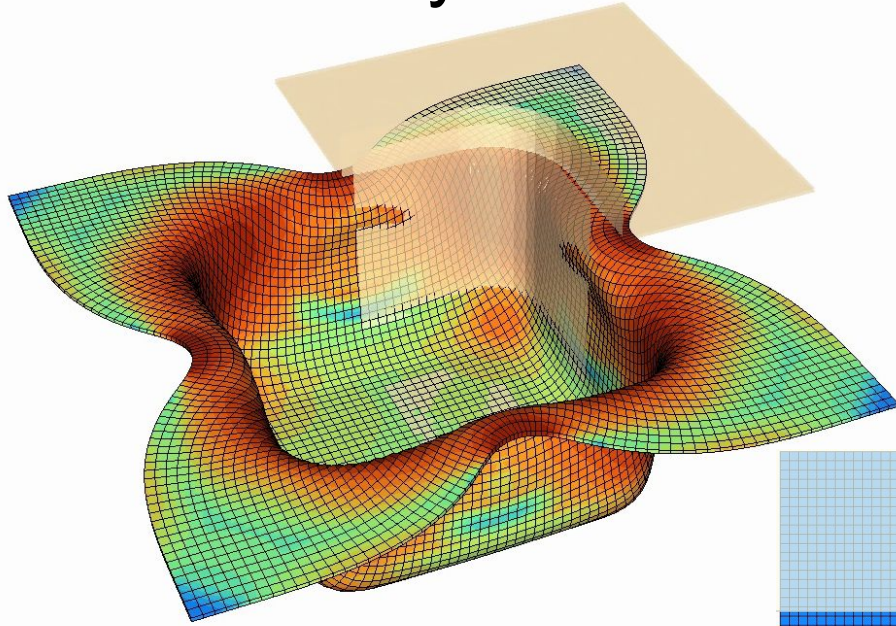
For every proposed benchmark in the conference we have access to:

- Full description of the process
- Raw material data for models characterization
- A lot of experimental and numerical results for validation (springback, thinning,...)

Metafor ♥ Metal Forming

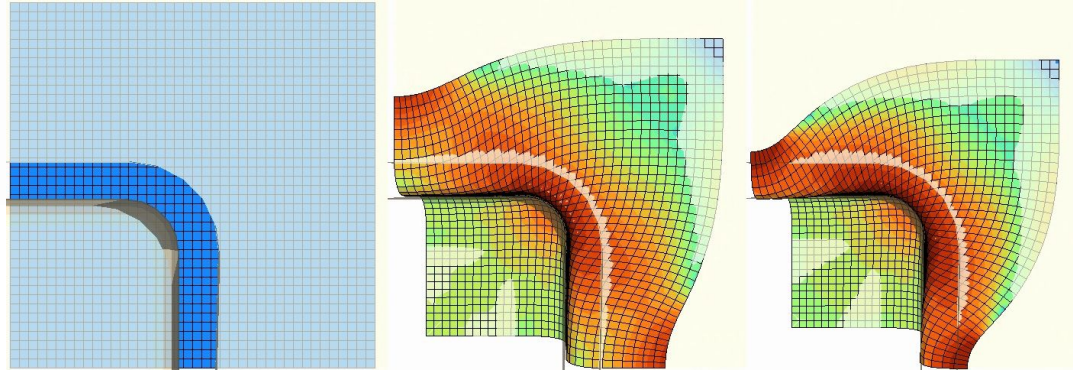


# And...Have you done some tests?



Quasi-static  
Isothermal  
VMS + Isotropic hardening

Numisheet 1993  
Square deep drawing



video...

# And...Have you done some tests?

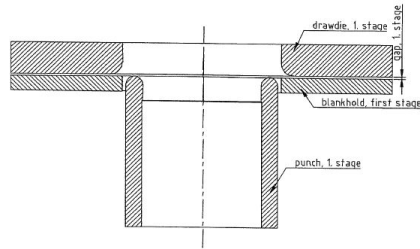


Figure C-1: Sketch of the tool set-up for the first stage (conventional deep drawing).

Stage 1.

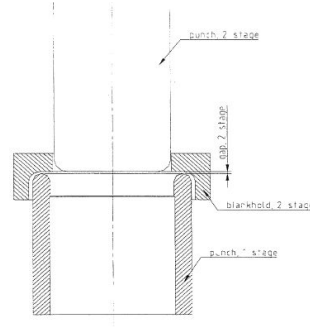
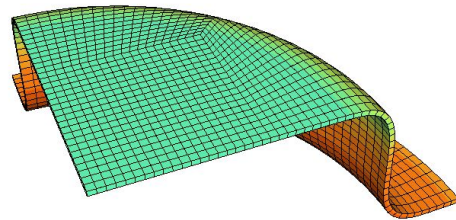
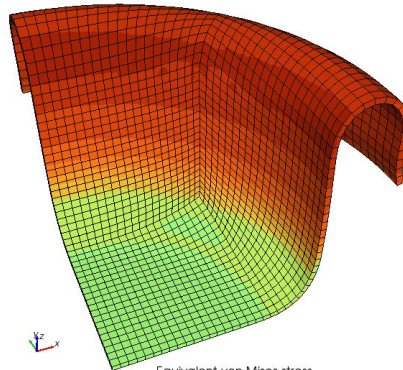


Figure C-5: Sketch of the tool set-up for the second stage (Reverse deep drawing).

Stage 2.



Numisheet 1999  
Reverse deep drawing

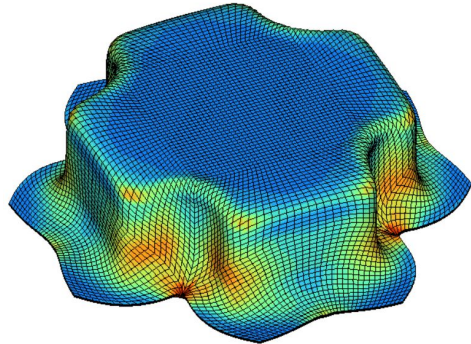
Quasi-static  
Isothermal  
VMS + Isotropic hardening

video...

# And...Have you done some tests?

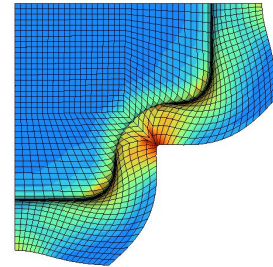
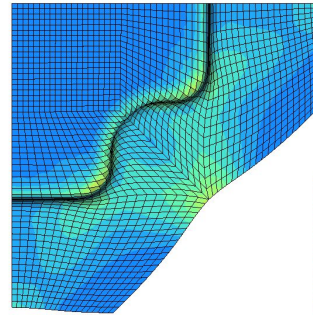
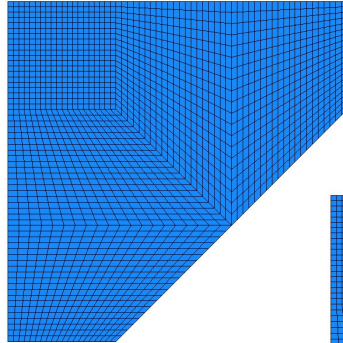


Figure 2.1 A cross-shaped deep-drawn cup



Quasi-static  
Isothermal (\*)  
Hill + Isotropic hardening

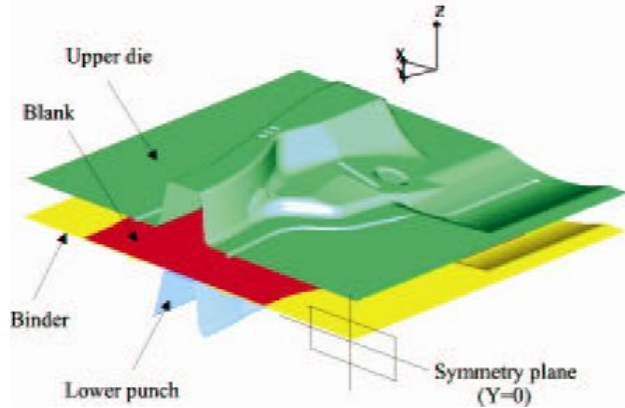
Numisheet 2011  
Cross-shaped deep drawing



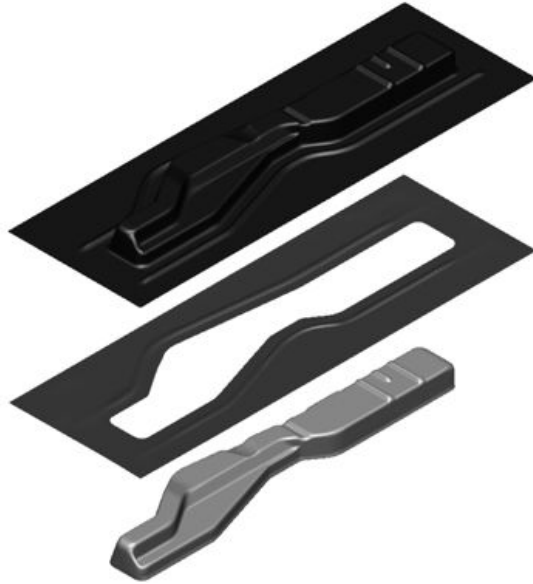
video...

# And some new challenges...

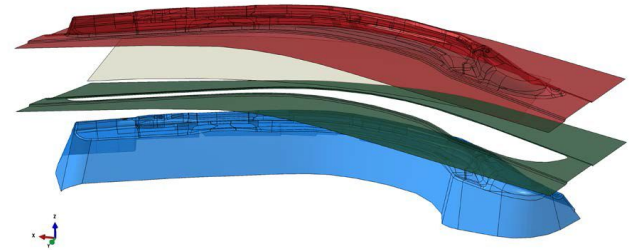
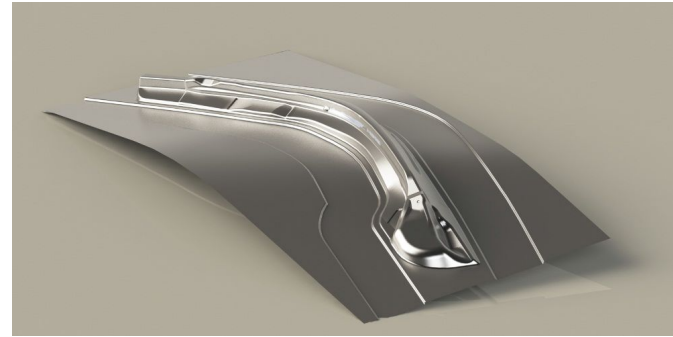
Numisheet 2005  
Cross-member (Chrysler)



Numisheet 2011  
Stamping



Numisheet 2016  
Forming of Jaguar panel



# The plan now is...

To join forces with Gaëtan in order to generate more complex test and validate our numerical predictions.

- Parallelisation of contact considering Parasolid
- Take into account frictional contact interactions
- Include more complex material models (yield criteria, anisotropy+kinematic hardening, ...)

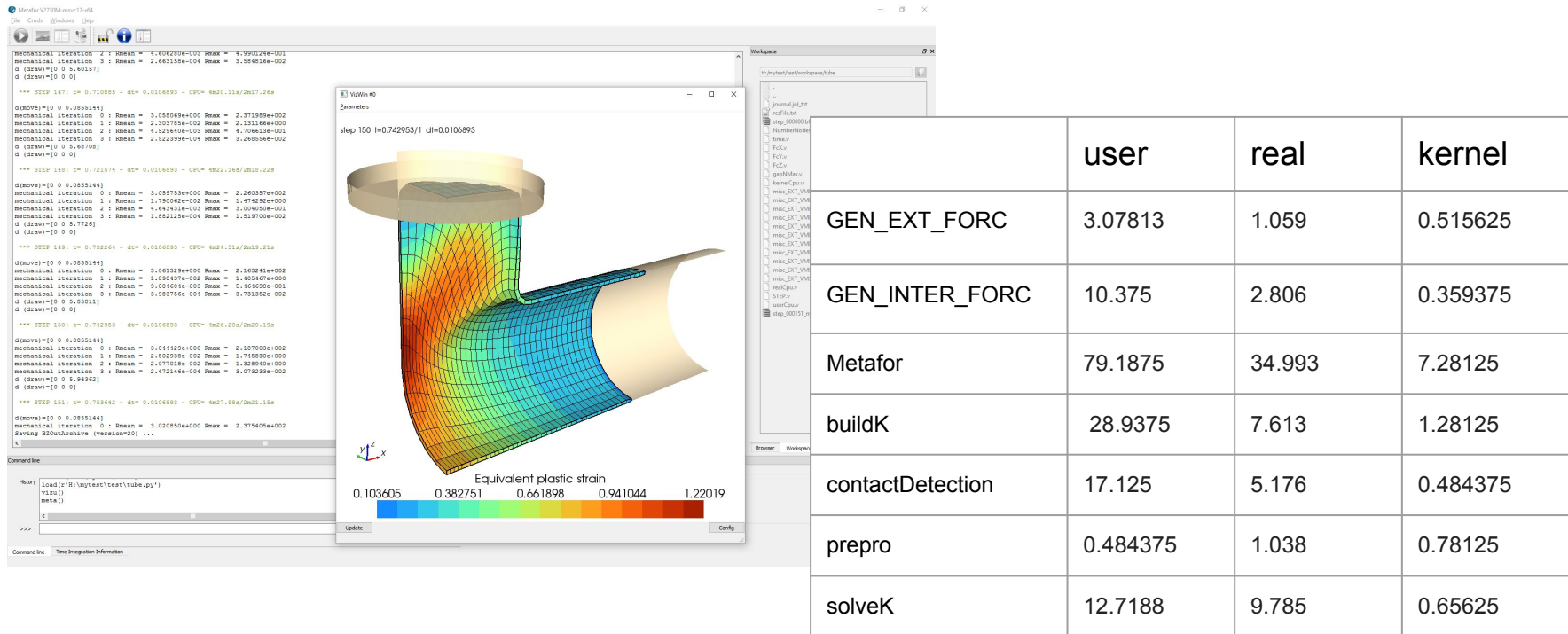
To generate a new kind of node selector to create groups based on: wires? projections? polygons ( $n > 4$ , convex and concave)?

To create a Numisheet folder with all the tests? oo\_nda?



# Some good news!

## Parallelisation of contact...



Time to play!